Quarterly Report 9 – Public Page

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Project Title: Achieving Maximum Crack Remediation Effect from Optimized Hydrotesting

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Background

Hydrotesting is one of the key techniques widely adopted for pipeline integrity management. A dilemma is created when hydrotesting is performed on pipelines experiencing stress corrosion cracking: hydrotesting eliminates defects of critical size and conditions sub-critical cracks to achieve a post-test period without operating failure; adversely it shortens remaining life because of crack growth during hydrotesting even for small SCC cracks according to the latest research findings. This project is aimed to determine how effective hydrotesting is toward crack remediation. Specifically, efforts will be made to establish a working model that will allow the industry to predict the overall benefits of hydrotesting. When hydrotesting is necessary, the model will help pipeline operators select the hydrotesting parameters that would generate the most effective crack remediation.

Progress in the Quarter

Project activities undertaken through the 9^{th} quarter focused on studying external conditions that may have an influence on crack growth during hydrotesting so that the external conditions can be modified to minimize hydrotesting damage.

In the previous reporting period, efforts were made in determining crack growth behavior of surface cracks under various level of cathodic protection. The results obtained will be used to compare the crack growth behavior of long cracks evaluated using compact tension specimens. In the current reporting period, we have analyzed all the hydrostatic simulations completed so far to determine the role of crack depth, hydrogen, room temperature creep and loading procedure in the crack growth during hydrostatic testing of pipeline steels exposed to near-neutral pH aqueous soil environments. Crack growth was found to occur during hydrostatic loading, but was not linearly related to the stress intensity factor at the crack tip. Crack growth is mainly driven through the internal-hydrogen-assisted cracking mechanism, instead of the environmental-hydrogen-assisted cracking mechanism. Room temperature creep prior to hydrostatic testing can reduce the crack growth during hydrostatic loading. Excessive plastic deformation leads to the formation of ductile dimples in the plastic zone and reduces crack advance during hydrostatic loading. Lower loading rate generally induces larger crack growth by hydrostatic loading. More crack growth occurs during loading in the high stress regime. Additional work was also performed to model the so-called "mechanical dormancy" of cracks in pipeline steel when cyclically loaded at very low frequencies.

Plans for Future Activity

- To focus on crack growth behavior after hydrotest and retest intervals.